CLAIMS:

1. A method of controlling a process performed by a semiconductor processing tool, comprising:

inputting data relating to a process performed by the semiconductor processing tool;

inputting a first principles physical model relating to the semiconductor processing tool;

performing first principles simulation using the input data and the physical model to provide a first principles simulation result; and

using the first principles simulation result to control the process performed by the semiconductor processing tool.

2. The method of Claim 1, wherein said inputting comprises directly inputting the data relating to a process performed by the semiconductor processing tool from at least one of a physical sensor and a metrology tool physically mounted on the semiconductor processing tool.

3. The method of Claim 1, wherein said inputting comprises indirectly inputting the data relating to a process performed by the semiconductor processing tool from at least one of a manual input device and a database.

4. The method of Claim 3, wherein said indirectly inputting comprises inputting data recorded from a process previously performed by the semiconductor processing tool.

5. The method of Claim 3, wherein said indirectly inputting comprises inputting data set by a simulation operator.

6. The method of Claim 1, wherein said inputting data comprises inputting data relating to at least one of the physical characteristics of the semiconductor processing tool and the semiconductor tool environment.

7. The method of Claim 1, wherein said inputting data comprises inputting data relating to at least one of a characteristic and a result of a process performed by the semiconductor processing tool.

8. The method of Claim 1, wherein said inputting a first principles physical model comprises inputting a spatially resolved model of the geometry of the semiconductor processing tool.

9. The method of Claim 1, wherein said inputting a first principles physical model comprises inputting fundamental equations necessary to perform first principles simulation for a desired simulation result.

10. The method of Claim 1, wherein said performing first principles simulation comprises performing first principles simulation concurrently with the process performed by the semiconductor processing tool.

11. The method of Claim 1, wherein said performing first principles simulation comprises performing first principles simulation independent of the process performed by the semiconductor processing tool.

12. The method of Claim 1, wherein said performing first principles simulation comprises using the input data to set a boundary condition of the first principles simulation model.

13. The method of Claim 1, wherein said performing first principles simulation comprises using the input data to set an initial condition of the first principles simulation model.

14. The method of Claim 1, wherein said using the first principles simulation result comprises using the first principles simulation result to perform at least one of detecting, and classifying a fault in the process performed by the semiconductor processing tool.

15. The method of Claim 1, further comprising using a network of interconnected resources to perform at least one of the process steps recited in Claim 1.

16. The method of Claim 15, further comprising using code parallelization among interconnected computational resources to share the computational load of the first principles simulation.

17. The method of Claim 15, further comprising sharing simulation information among interconnected resources to control the process performed by the semiconductor processing tool.

18. The method of Claim 17, wherein said sharing simulation information comprises distributing simulation results among the interconnected resources to reduce redundant execution of substantially similar first principles simulations by different resources.

19. The method of Claim 17, wherein said sharing simulation information comprises distributing model changes among the interconnected resources to reduce redundant refinements of first principles simulations by different resources.

20. The method of Claim 15, further comprising using remote resources via a wide area network to control the semiconductor process performed by the semiconductor processing tool.

21. The method of Claim 21, wherein said using remote resources comprises using at least one of remote computational and storage resources via a wide area network to facilitate the semiconductor process performed by the semiconductor processing tool.

22. The method of Claim 1, wherein said performing first principles simulation utilizes at least one of an ANSYS computer code, a FLUENT computer code, a CFRDC-ACE computer code, and a direct simulation Monte Carlo computer code.

23. The method of Claim 1, wherein said performing first principles simulation comprises:

calculating a solution to the first principles simulation by applying a close-fitting solution to thereby set initial conditions for cells in the first principles simulation.

24. The method of Claim 23, wherein said calculating comprises:

selecting said close-fitting solution from a library of solutions.

25. The method of Claim 24, wherein said selecting comprises:

selecting a solution from the library of solutions that has proven convergence on the semiconductor processing tool.

26. The method of Claim 23, wherein said selecting comprises:

selecting said close-fitting solution from a library of solutions existing on a network of computers connected to said semiconductor processing tool.

27. The method of Claim 1, wherein said performing first principles simulation comprises:

calculating a solution to the first principles simulation by choosing a coarse grid for solution to the first principles simulation.

28. The method of Claim 27, wherein said calculating a solution further comprises:

utilizing the solution of the coarse grid to set initial conditions for cells in a subsequent first principles simulation using a fine grid.

29. The method of Claim 1, wherein said using the first principles simulation result to control the process comprises:

performing a principle components analysis to determine a relationship between spatial components of said first principles simulation result for the semiconductor processing tool and a set of at least one control variable, said relationship utilized to determine a correction to said set of at least one control variable in order to affect a reduction in the magnitude of said spatial components.

30. The method of Claim 1, wherein said using the first principles simulation result to control comprises:

controlling at least one of a material processing system, an etch system, a photoresist spin coating system, a lithography system, a dielectric coating system , a deposition system , a rapid thermal processing system for thermal annealing, and a batch diffusion furnace.

31. The method of Claim 30, wherein said using the first principles simulation result to control comprises:

controlling at least one of a chemical vapor deposition system and a physical vapor deposition system.

32. The method of Claim 21 wherein said inputting tool data comprises:

inputting at least one of etch rate, deposition rate, etch selectivity, an etch critical dimension, an etch feature anisotropy , a film property, a plasma density, an ion energy, a concentration of a chemical specie, a photoresist mask film thickness, a photoresist pattern dimension.

33. The method of Claim 1, wherein said inputting data comprises:

inputting physical geometric parameters of at least one of a material processing system, an etch system, a photoresist spin coating system, a lithography system, a dielectric coating system, a deposition system , a rapid thermal processing system for thermal annealing, and a batch diffusion furnace.

34. The method of Claim 1, wherein said using the first principles simulation result to control comprises:

controlling the semiconductor processing tool by using model output to adjust said process performed by the semiconductor processing tool.

35. The method of Claim 34, wherein said controlling comprises:

utilizing at least one of nonlinear optimization and multivariate analysis to derive a control model for process control.

36. The method of Claim 1, further comprising:

exchanging information between a plurality of computing/storage devices including at least one of model solver parameters, solution status to the first principles simulation, model

solutions to the first principles simulation, and solution convergence history for said model solutions.

37. The method of Claim 1, further comprising:

inspecting process results; and

providing input to the first principles simulation for calibration purposes.

38. A system comprising:

a semiconductor processing tool configured to perform a process;

an input device configured to input data relating to the process performed by the semiconductor processing tool; and

a first principles simulation processor configured to:

input a first principles physical model relating to the semiconductor processing tool, and

perform first principles simulation using the input data and the physical model to provide a first principles simulation result, wherein said first principles simulation result is used to control the process performed by the semiconductor processing tool.

39. The system of Claim 38, wherein said input device comprises at least one of a physical sensor and a metrology tool physically mounted on the semiconductor processing tool.

40. The system of Claim 38, wherein said input device comprises at least one of a manual input device and a database.

41. The system of Claim 40, wherein said input device is configured to input data recorded from a process previously performed by the semiconductor processing tool.

42. The system of Claim 40, wherein said input device is configured to input data set by a simulation operator.

43. The system of Claim 38, wherein said input device is configured to input data relating to at least one of the physical characteristics of the semiconductor processing tool and the semiconductor tool environment.

44. The system of Claim 38, wherein said input device is configured to input data relating to at least one of a characteristic and a result of a process performed by the semiconductor processing tool.

45. The system of Claim 38, wherein said processor is configured to input a first principles physical model comprising a spatially resolved model of the geometry of the semiconductor processing tool.

46. The system of Claim 38, wherein said processor is configured to input a first principles physical model comprising fundamental equations necessary to perform first principles simulation for a desired simulation result.

47. The system of Claim 38, wherein said processor is configured to perform said first principles simulation concurrently with the process performed by the semiconductor processing tool.

48. The system of Claim 38, wherein said processor is configured to perform said first principles simulation not concurrently with the process performed by the semiconductor processing tool.

49. The system of Claim 38, wherein said processor is configured to perform said first principles simulation at least by using the input data to set a boundary condition of the first principles simulation model.

50. The system of Claim 38, wherein said processor is configured to perform said first principles simulation at least by using the input data to set an initial condition of the first principles simulation model.

51. The system of Claim 38, wherein said processor is configured to use the first principles simulation result to perform at least one of detecting, and classifying a fault in the process performed by the semiconductor processing tool.

52. The system of Claim 38, further comprising a network of interconnected resources connected to said processor and configured to assist said processor in performing at least one of the inputting a first principles simulation model and performing a first principles simulation.

53. The system of Claim 52, wherein said network of interconnected resources is configured to use code parallelization with said processor to share the computational load of the first principles simulation.

54. The system of Claim 52, wherein said network of interconnected resources is configured to share simulation information with said processor to facilitate said process performed by the semiconductor processing tool.

55. The system of Claim 54, wherein said network of interconnected resources is configured to distribute simulation results to said processor to reduce redundant execution of substantially similar first principles simulations.

56. The system of Claim 54, wherein said network of interconnected resources is configured to distribute model changes to said processor to reduce redundant refinements of first principles simulations.

57. The system of Claim 52, further comprising remote resources connected to said processor via a wide area network and configured to facilitate the semiconductor process performed by the semiconductor processing tool.

58. The system of Claim 57, wherein said remote resources comprise at least one of a computational and a storage resource.

59. The system of Claim 38, wherein said processor is configured to perform first principles simulation utilizes at least one of an ANSYS computer code, a FLUENT computer code, a CFRDC-ACE computer code, and a direct simulation Monte Carlo computer code.

60. The system of Claim 38, wherein said processor is configured to perform first principles simulation at least by calculating a solution to the first principles simulation by applying a close-fitting solution to thereby set initial conditions for cells in the first principles simulation.

61. The system of Claim 60, wherein said processor is configured to perform said calculating by at least selecting said close-fitting solution from a library of solutions.

62. The system of Claim 61, wherein said processor is configured to perform said selecting by at least selecting a solution from the library of solutions that has proven convergence on the semiconductor processing tool.

63. The system of Claim 60, wherein said processor is configured to perform said selecting by at least selecting said close-fitting solution from a library of solutions existing on a network of computers connected to said semiconductor processing tool.

64. The system of Claim 38, wherein said processor is configured to perform first principles simulation by at least calculating a solution to the first principles simulation by choosing a coarse grid for solution to the first principles simulation.

65. The system of Claim 64, wherein said processor is configured to perform calculating a solution by at least utilizing the solution of the coarse grid to set initial conditions for cells in a subsequent first principles simulation using a fine grid.

66. The system of Claim 38, wherein said processor is configured to use the first principles simulation result to control the process by at least performing a principle components analysis to determine a relationship between spatial components of said first principles simulation result for the semiconductor processing tool and a set of at least one

control variable, said relationship utilized to determine a correction to said set of at least one control variable in order to affect a reduction in the magnitude of said spatial components.

67. The system of Claim 38, wherein said processor is configured to use the first principles simulation result to control the process by at least controlling at least one of a material processing system, an etch system, a photoresist spin coating system, a lithography system, a dielectric coating system, a deposition system , a rapid thermal processing system for thermal annealing, and a batch diffusion furnace.

68. The system of Claim 67, wherein said processor is configured to use the first principles simulation result to control the process by controlling at least one of a chemical vapor deposition system and a physical vapor deposition system.

69. The system of Claim 38 wherein said input device is configured to input at least one of etch rate, deposition rate, etch selectivity, an etch critical dimension, an etch feature anisotropy , a film property, a plasma density, an ion energy, a concentration of a chemical specie, a photoresist mask film thickness, a photoresist pattern dimension.

70. The system of Claim 38, wherein said input device is configured to input physical geometric parameters of at least one of a material processing system, an etch system, a photoresist spin coating system, a lithography system, a dielectric coating system, a deposition system , a rapid thermal processing system for thermal annealing, and a batch diffusion furnace.

71. The system of Claim 38, wherein said processor is configured to use the first principles simulation result to control the process by at least controlling the semiconductor processing tool by using model output to adjust said process performed by the semiconductor processing tool.

72. The system of Claim 71, wherein said processor configured to perform said controlling by utilizing at least one of nonlinear optimization and multivariate analysis to derive a control model for process control.

73. The system of Claim 38, wherein said processor is further configured to exchange information between a plurality of computing/storage devices including at least one of model solver parameters, solution status to the first principles simulation, model solutions to the first principles simulation, and solution convergence history for said model solutions.

74. The system of Claim 38, wherein said processor is further configured to:

inspect process results; and

provide input to the first principles simulation for calibration purposes.

75. A system for facilitating a process performed by a semiconductor processing tool, comprising:

inputting data relating to a process performed by the semiconductor processing tool;

means for inputting a first principles physical model relating to the semiconductor processing tool;

means for performing first principles simulation using the input data and the physical model to provide a first principles simulation result; and

means for using the first principles simulation result to control the process performed by the semiconductor processing tool.

76. The system of Claim 75, further comprising means for sharing the computational load of the first principles simulation.

77. The system of Claim 75, further comprising means for sharing simulation information among interconnected resources to facilitate a process performed by the semiconductor processing tool.

78. A computer readable medium containing program instructions for execution on a processor, which when executed by the computer system, cause the processor to perform the steps of:

inputting data relating to a process performed by the semiconductor processing tool;

inputting a first principles physical model relating to the semiconductor processing tool;

performing first principles simulation using the input data and the physical model to provide a first principles simulation result; and

using the first principles simulation result to control the process performed by the semiconductor processing tool.